

UNUSUAL CALCITE AND PYRITE CRYSTALS FROM SHELBURNE, MASSACHUSETTS

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During the period from the latter part of 1950 to the early part of 1952 a highway cut-off was constructed along the Mohawk Trail, Massachusetts Route No. 2 at Shelburne in order to straighten the road. About a quarter of a mile west of the village a rather deep rock cut, Fig. 1, was made through the strongly metamorphosed Conway schist for about three-eighths of a mile. It appears that during the period of construction and the summer of 1952 the mineral-bearing possibilities of the excavation were completely overlooked by the collectors in and out of the area. The Conway Schist here, as throughout its areal extent, contains beds of various compositions varying from those which are very siliceous to some which are very rich in fine-grained calcite as well as many beds of schist of varying compositions. It is not uncommon to find in metamorphic rocks of such diversified composition, many interesting and sometimes unusual minerals originat-

ing from solutions which were expelled during the metamorphic processes and which have been squeezed into fissures or cavities formed by the dynamic processes in folding and faulting the beds.

It was not until October 19, 1952, when the authors accompanied a group of teachers and students of the New England Intercollegiate Geological Conference that the fine calcite crystals were discovered. The last stop made by the group, under the leadership of Professor Freeman Foote of Williams College, Fig. 2, was at this highway cut to observe the variations in the Conway Schist when the junior author observed a few crystals in what appeared to be a small and partly filled fissure on the south side of the cut and slightly west of the middle section. The unusual shape of the crystals (with few exceptions they consisted of prisms and bases only), their large size, Fig. 3, (the largest crystals were $2\frac{1}{2}$ inches between opposite prism faces and nearly 3 inches long), and clear



FIG. 1—"Big Cut" looking east, on Mohawk Trail Massachusetts Route No. 2, one-quarter of a mile west of Shelburne. Calcite-pyrite vein is located on the south side near middle of cut.

cut crystal forms shrouded the mineral in mystery for a short time to the young mineralogists. Their eagerness to secure specimens with inadequate tools and without giving due consideration to the friable nature of the mineral would have been disastrous, it was feared, to most of the specimens had the work continued unabated for even a short time.

The importance of the discovery was quickly recognized by the senior author

who provided adequate tools from his car and who exercised considerable care in excavating the rock walls of the vein material so as to avoid as much injury as possible to the delicate crystals. In the removal of the crystal specimens we were fortunate that a considerable part of the cavity walls were covered with a slickensided gouge or were broken into relatively thin more-or-less flat, irregular pieces, Fig. 4, by roughly parallel frac-



FIG. 2—Professor Freeman Foote, Department of Geology, Williams College, leader of the field trip, shows his admiration for the fine large calcite crystal excavated from the mud at the bottom of the calcite vein.

turing which permitted the removal of a considerable number of good hand and museum specimens.

The nearly vertical fissure usually cuts across the bedding at a relatively low angle. Movement along the fissure had created a very irregular opening, Fig. 5, where the vein material occurred. The cavity was about 5 feet in vertical dimension and about 10 inches at the widest place. The opening along the strike of the fissure near roadbed level was approximately three feet. It is not known how far the fissure extended out into the rock excavated from the cut. Its extension into the south wall can still be seen and it probably continues for some distance and may again expand into another opening in which a similar deposition of calcite had occurred contemporaneously with that in the cavity we exploited. The principal part of the fissure was at the level of the highway where it had been filled with

debris from the blasting which had concealed the opening. The removal of the broken rock and some of the west wall revealed the crystal lined sides of the cavity at its greatest width. From the debris in the mud in the bottom of the cavity, and mixed with it, about a dozen good to superb crystals or crystal-covered fragments of the wall, Fig. 6, were obtained. These had been loosened from the walls and blown back into the cavity by the force of the blasts when the highway construction was in progress.

During the operations of removing the crystals and/or crystal covered sections of the walls there were always many eager hands waiting to share in the booty. It is quite probable that never in the history of New England mineralogy has the discovery and recovery of such an unusual deposit of minerals been witnessed by as many professional and amateur mineralogists and the products of the dis-

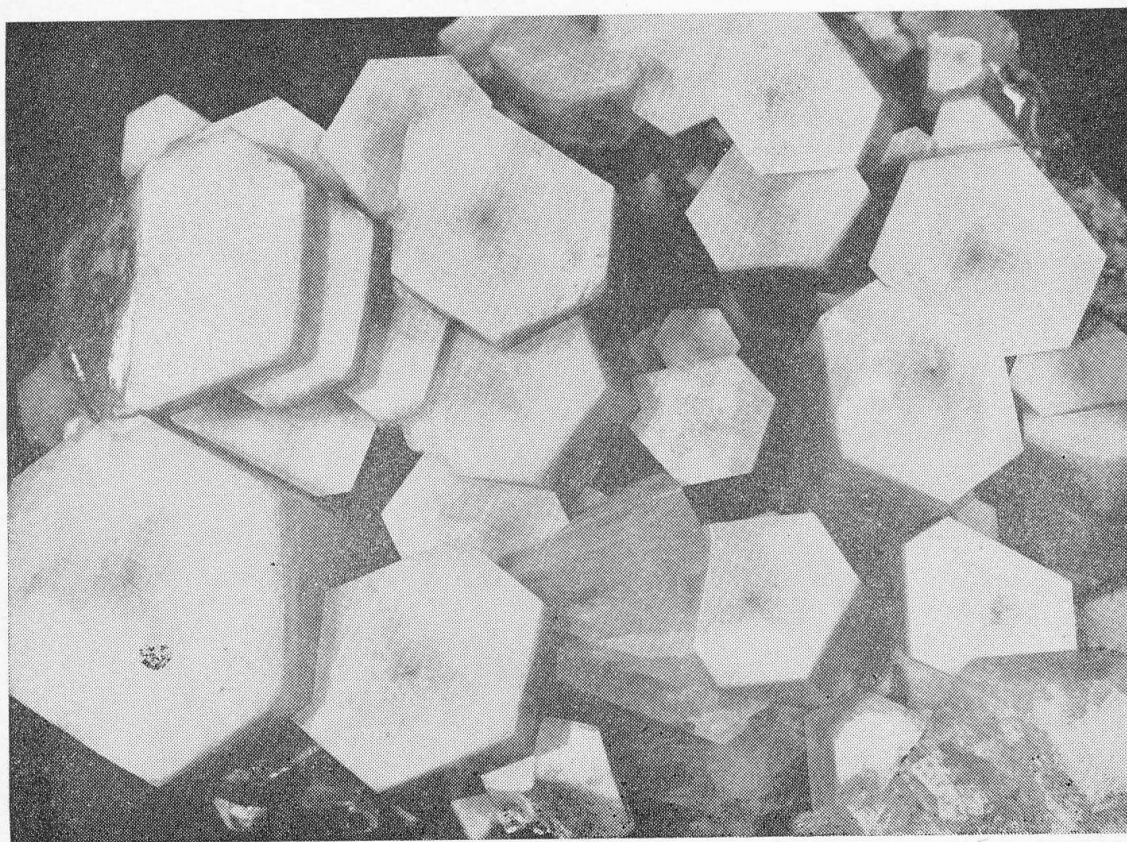


FIG. 3—A group of the calcite crystals showing the sharp crystal outlines and the white bases with dark spots representing buried pyrite groups. About natural size.



FIG. 4—East wall of calcite-lined cavity showing the relationship of the crust to the fractured wall rock. Exposed height about 20 inches.

covery so widely distributed among institutions and individuals interested in minerals; and, the senior author might add, with such a negligible return to the discoverer, as in this instance.

Most of the calcite was removed by the end of the first day; however, some good crystal groups were still visible where the vein was pinching out and the walls were so close together, Fig. 5, that



FIG. 5—The fissure as it pinched out into the south wall of the cut. Note parallel vein at upper left. The large crystals near the top broke along cleavage planes as they were attached very firmly to the wall rock. Exposed height about two feet.

it was becoming quite difficult to progress further. During the next few weeks the side walls consisting of the quite solid rock were gradually chiseled away by the more ardent collectors who visited the location and who reported that additional crystals and crystal groups were removed. At the present time the fault fissure still is evident and a thin vein of calcite marks the present visible end of a most unusual mineral deposit which may be said to have had a meteoric existence when once discovered that is, appearing and disappearing in a flash-of geologic time at least.

One may wonder and ask the question, "just how unusual is the calcite from the Shelburne 'Big cut'?" At one locality, Andreasberg, Harz Mountains region, Germany, calcite occurs where the prism and basal pinacoid habit is common, Fig. 7. The crystals from this locality contain several white, translucent zones parallel to the base and the base consists of the same material. In addition to the

well-known German locality, Goldschmidt in his voluminous atlas of crystal forms lists the following localities: Marienberg, Harz, Germany; Cumberland, England; Strontian, Scotland; and Orkusak, Greenland. Dr. William F. Foshag, Head Curator, Department of Geology, Smithsonian Institution, informed the senior author that there was, in the collection of the institution, calcite having this habit from two localities, Franklin, New Jersey and Andreasberg, Germany. In a letter from Dr. V. B. Meen, Director of the Royal Ontario Museum at Toronto, reference was made to calcite of the same habit from Liskard, Cornwall, England and Port Arthur, Ontario. The senior author has a micro-mount of calcite of the same habit from the Westfield, Massachusetts trap rock quarries, except that three of the base edges are slightly truncated by a rhombohedron which is also a form present on some of the crystal groups from Andreasberg, Cornwall and Shelburne. Crystals from all of the localities

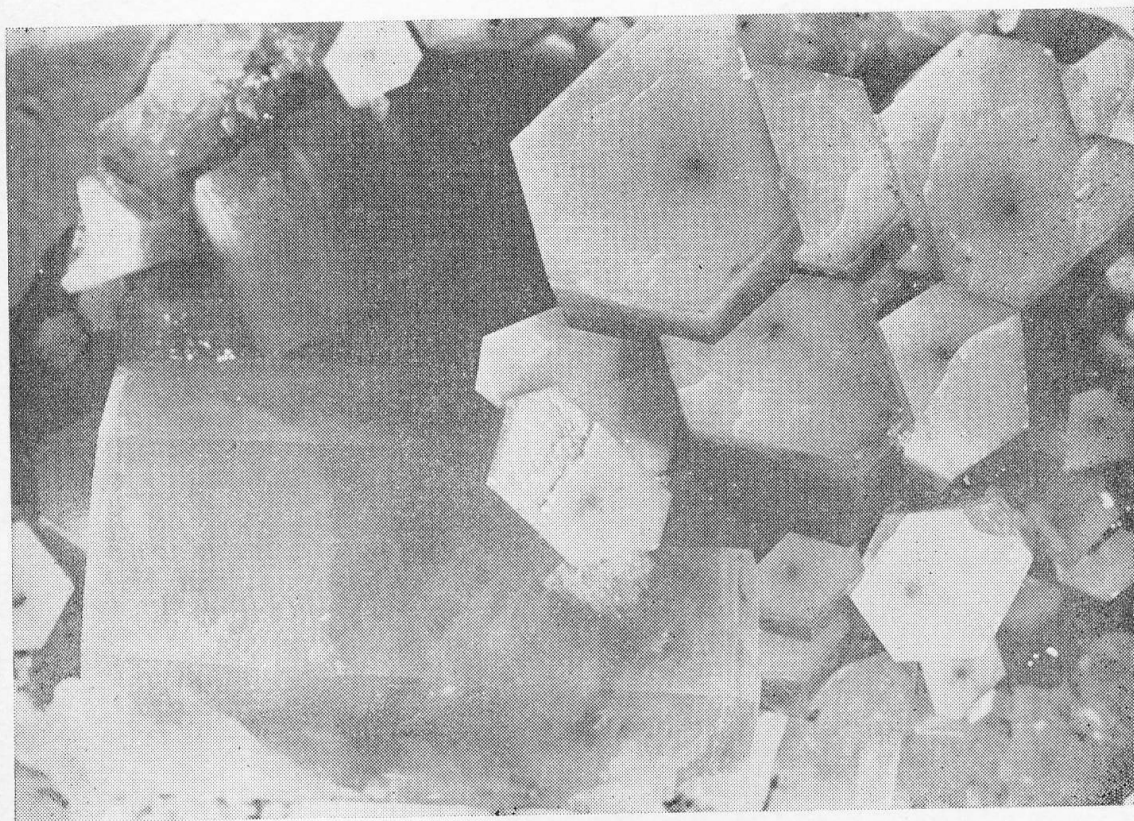


FIG. 6—A crystal group recovered from the mud in the bottom of the crystal cavity. Large horizontal crystal is $2\frac{3}{4}$ inches long. Note black spots in bases which represent covered pyrite groups. Specimen of Mr. Russell Dutcher.

seen by us have the white translucent bases; hence the cause of this feature of the crystals is likely to have had an influence on the crystal habit of the calcite.

The mineral calcite is noted for the complexity of its crystal forms as well as the unusual widespread occurrence of good to excellent crystals from microscopic proportions up to over 1200 pounds for a twinned crystal from Sterlingbush, Lewis County, New York. About 700 crystal forms have been described for calcite. The simplest of all the crystal habits of the mineral is probably that of the rhombohedron which often occurs alone and is not uncommon in many localities where the crystals consist of this single closed form. The Shelburne calcite, except for the small crystals in the parallel veins, consists of two simple open forms, the prism and basal pinacoid with occasional slight development of the rhombohedron and scalenohedron.

It is interesting to note that the eager hands already referred to at the calcite deposit were waiting patiently for the larger crystals while the small ones in the narrow parallel veins were little short of being frowned upon. It was difficult to protect them from being trampled under the many feet milling about the "portal" of the cavity. Yet the story of the development of the large crystals starts with that of the minute ones which first lined the cavity walls and upon which the larger crystals expanded as they developed and covered the many small ones so that their development could not continue. Many of the narrow parallel fissures contained the early crystals which no doubt covered all of the wall space at first in both the large and small cavities. In the latter the growth of the crystal crusts finally sealed them off from the supply of calcium and carbonate ions and hence did not continue to grow but they remained as most



FIG. 7—Calcite from Andreasberg, Germany showing only the prominent prism and base. A few very small rhombohedron faces are present. The crystals contain a number of white zones of which the base is one. $X = 1.3$.

interesting samples of the early small calcite crystals. Succeeding stages of development are marked by the increasing size of the crystals and their changing habits before they too were more-or-less isolated in their respective cavities from the succeeding and probably somewhat changing solutions carrying chiefly a supply of calcium carbonate.

An examination of the larger calcite crystals reveals some interesting features. If one holds some of the larger crystals so as to obtain a reflection from the prism face he will notice very low elevated pointed figures, Fig. 8, which appear to be overgrowth figures, on their surfaces. The low sloping sides forming the figures represent vicinal faces of the negative scalenohedron. A Cornwall specimen shows the same overgrowth figures to be very well developed while the surface

figures of the Andreasberg specimens appear to be less pointed and not as sharply developed. They frequently show a very irregular complex arrangement of the surface markings.

The white bases of the calcite presented some problems as to their probable origin. The basal pinacoid is one of the less common forms on calcite, and when it occurs it is often marked by a milky white color indicating that there are many inclusions within the material or discontinuities of the crystal lattice, both of which scatter the light and produce a white band or patches depending on their distribution. By holding a base so as to get a beam of light reflected from the surface one can at once see it to be made of granular bladed aggregates oriented in general perpendicular to the base edges. The blades give strong light reflections



FIG. 8—Overgrowth figures, vicinal negative scalenohedron faces on the front prism, a 1010 face of the calcite. $X = 10.6$.

under a binocular microscope. Due to the aggregation of the loosely bonded, irregular grains in the base, the hardness here is much less than on the prism faces or on a section across a single uniform crystal cut perpendicular to the vertical axis. The white base can easily be scratched with the finger nail. A thin section was made from material at the very surface of the base. It showed a fine-grained bladed aggregate having a very high birefringence. Aragonite would have the same appearance under the polarizing microscope; hence an x-ray powder picture was made of a sample of the bladed material. A small amount of fine powder was scratched from the base for this purpose.

A comparison of the base material with a cleavage piece of transparent calcite from New Mexico and aragonite from the Big Cut, Shelburne, Massachusetts is shown in Fig. 9. From these illustrations it is seen at once that the white base is also calcite. The whiteness is undoubtedly due to the scattering of light by the granular nature of the material. The bladed, granular aggregate is parallel to the base which accounts for the so-called basal parting in the white zones. If the edges

of the white base are examined, one will find it to be made up of both white and clear laminations which show that there is a sharp variation in the material in the base. One will also note that the white laminated portion is actually sitting upon a former rather flat rhombohedron. The same phenomenon is present in specimens from the Andreasberg locality. Rarely is one able to separate a "cap" entirely or in part from the rhombohedron face. Crystals that are similarly terminated by rhombohedrons are common in a few of the adjacent small veins which nearly parallel the main one containing the large crystals. It appears, therefore, that the development of the basal pinacoids on the Shelburne calcite is due to an irregular deposition of colloidal calcium carbonate on the earlier rhombohedron terminal faces while on the prism faces the deposition built up the normal crystal structure. The colloidal material later crystallized into the bladed variety now in part forming the basal ends. While the colloidal material was being deposited on the ends, the prism faces grew outward a small fraction of an inch. This is evident by the presence of a thin film of pyrite on the earlier prism faces as

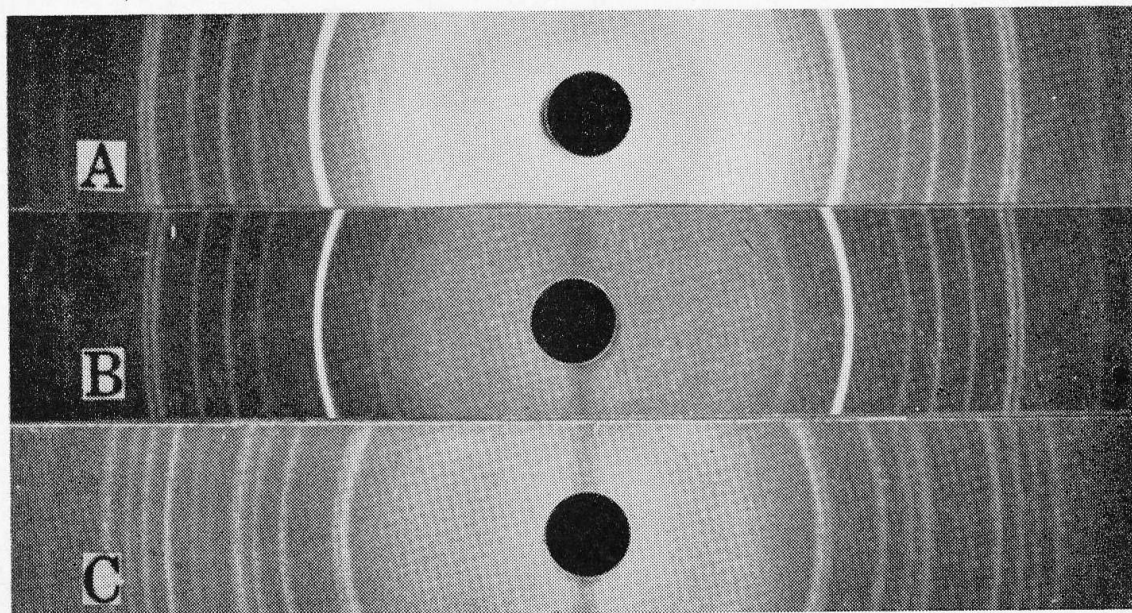


FIG 9—X-ray diffraction pictures showing A, white base material, Shelburne calcite; B, transparent cleavage of calcite, New Mexico; and C, aragonite from the Big Cut, Shelburne, Massachusetts. These show the white bases of the calcite crystals to be made up of calcite also.

well as scattered flat crystals of pyrite. At this period a cluster of intergrown pyrite crystals developed at the apex of the rhombohedron terminations and was at times completely covered. The presence of the covered pyrite in many of the crystals is clearly indicated by a dark spot within the translucent base, Figs. 3 and 6. An occasional group of pyrite crystals grew too large to be covered and about these a number of radial fractures now occur which indicates the presence of contraction forces during the recrystallization of the colloidal deposit on the base. The thin layer of calcite over the earlier arrested phase of the crystal growth contains numerous cleavage fractures which penetrate only as far as the early crystal surfaces which indicates a discontinuity of the crystal lattice at the earlier crystal boundary prior to the colloidal deposits on the terminals.

The only additional minerals in the calcite crusts are pyrite and quartz which is abundant on a few specimens from the narrow fissures. Terminated quartz crystals occur only in the thin crusts near the walls, where they were usually covered by calcite. Of these the pyrite is especially interesting but the entire description of the interesting variations and habits of this mineral cannot be given here. A few of the more striking phases can, however, be enumerated. The most striking of these consist of a single crystal of pyrite occupying the near central position on the base of the calcite. At times the central position of the base was occupied by a spherical group of pyrite crystals having a cubic habit and with cube faces appearing almost like facets on a sphere with a very irregular groove between the adjacent faces. At other times the habit of the pyrite was octahedral in which case the pyrite appeared like a spherical mass with numerous stubby spines projecting from the surface. A distorted octahedral habit is also common in which the crystals were nearly thin, flat isosceles triangles with the points truncated by small cubes. Thin triangular plates frequently built up a petal-like arrangement in nearly parallel overlapping growths

thereby producing a beautiful micro-pyrite rose.

There are many other details of the above minerals that are worthy of description but space does not permit further elucidation at this time.

There are about 15 additional mineral species occurring in other fissure veins in the Conway Schist from the Big Cut. While none of these are as spectacular as the calcite and pyrite, they too are of interest to many mineral collectors and the senior author hopes to describe them in the not too distant future.

EASTERN FEDERATION CONVENTION SCHEDULED FOR OCTOBER, 1954

The following telegram, dated Dec. 10, 1953, was received from the executive vice president, Henry B. Graves, 3154 N. W. 27th St., Miami 42, Fla.

"1954 convention and exhibition of the Eastern Federation of Mineralogical and Lapidary Societies will be held Oct. 14, 15, and 16, 1954, in Miami Municipal Auditorium and Biscayne Terrace Hotel, Miami, Fla. Advertising schedule being developed and pending completion your editorial handling will be appreciated."

Available as Lecturer

Andrew M. Dudley, Box 215, Barry, Ill., is available as a lecturer and his specialty are the twelve stones of the Bible. The stones will be exhibited under a Mineralight with a brief description of each stone; a description of the Holy City will also be included.

Mr. Dudley is a member of the Rocks and Minerals Association.

Picture on the Cover

The picture on the cover is a very fine moss agate from Friday Ranch, near Madras, Jefferson Co., Ore. It is a 4 x 7 inch nodule and because of its resemblance to a woman's head and bust, is called "Martha Washington" by its owner. The outline is chocolate-brown in color; face light blue and white; lower bust darker blue; flowers on hat white and pink.

From the Ken Dor Rock Roost Collection, 419 Sutter Ave., Modesto, Calif.